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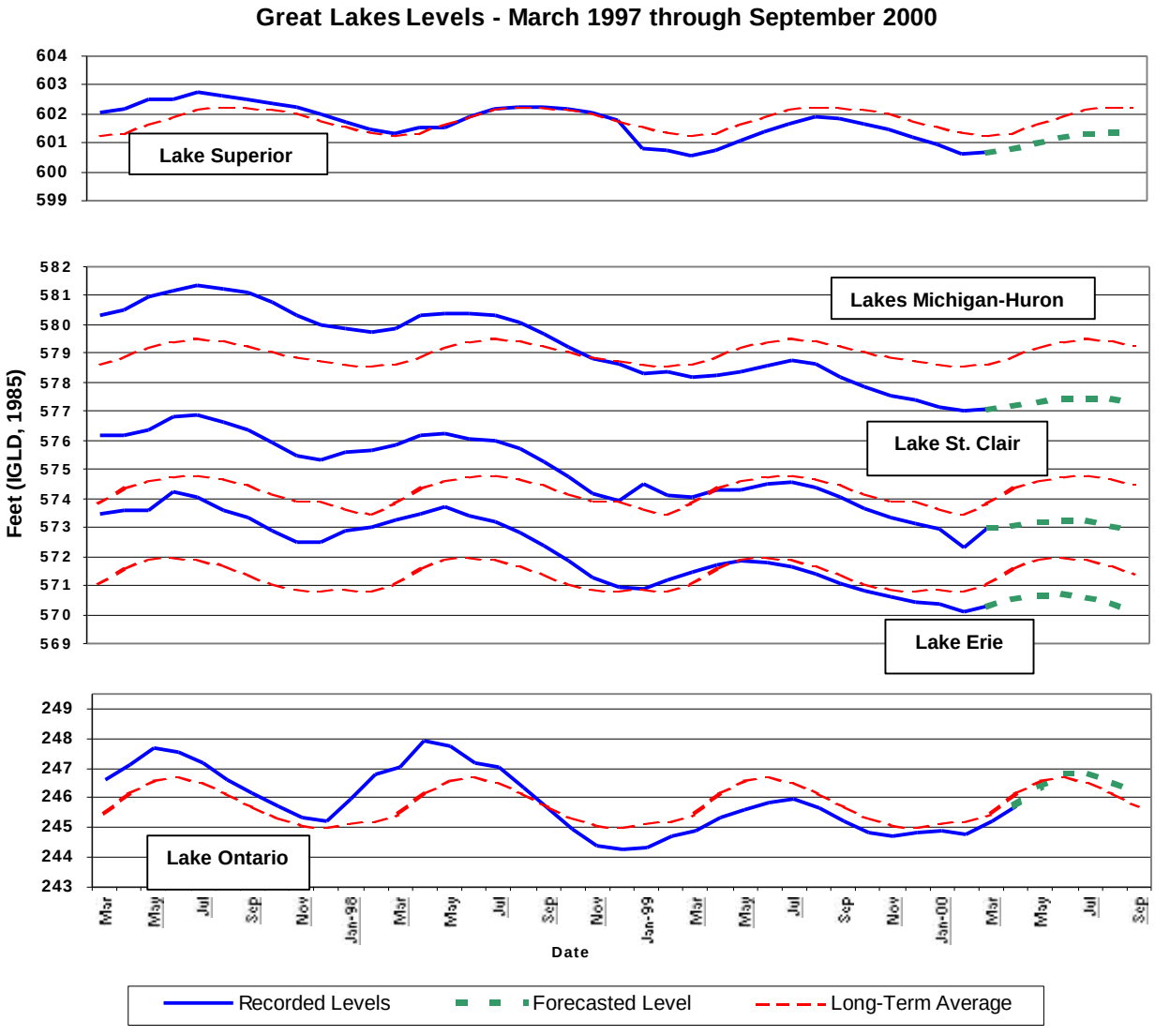
US Army Corps of Engineers
Detroit District

Great Lakes Update

Water Levels Continue to Decline

In the April 1999 issue of the update, we took a look at falling Great Lakes water levels. Last year, water levels on lakes Michigan-Huron, St. Clair and Erie had fallen from near-record highs in 1997 to below average levels. This fall has continued over the last year. The graph below shows recorded water levels for the past 36 months and the forecasted levels through August 2000.



Current Conditions

Great Lakes water levels are affected by several natural and man-made factors. The amount of water entering the Great Lakes is determined almost entirely by nature. Precipitation, snowmelt runoff, and groundwater help supply the Great Lakes. Evaporation over the lake surface and drainage basins plays a significant role in water leaving the Great Lakes along with the outflow from each lake.

Water levels were generally within inches of record high levels during 1997 following two years of above normal rain and snowfall across the northern Great Lakes. Since that time, precipitation has been consistently below average across the Great Lakes. Also, warmer temperatures have resulted in increased evaporation and reduced ice cover during the last three winters.

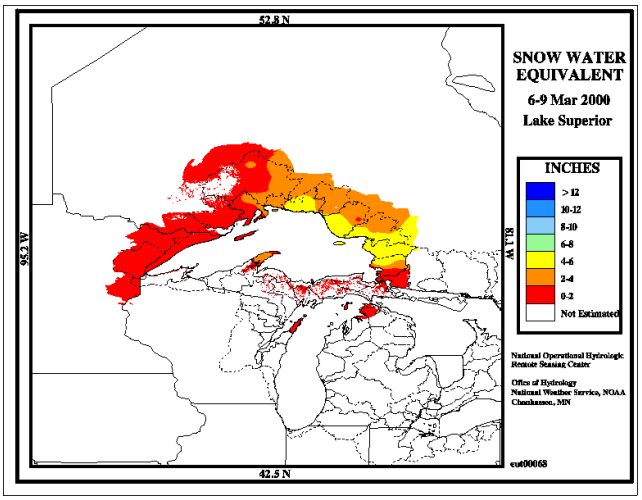
The year 2000 continues to show the decline of water levels, with a threat of levels approaching record lows for lakes Michigan-Huron and St. Clair later in the year.

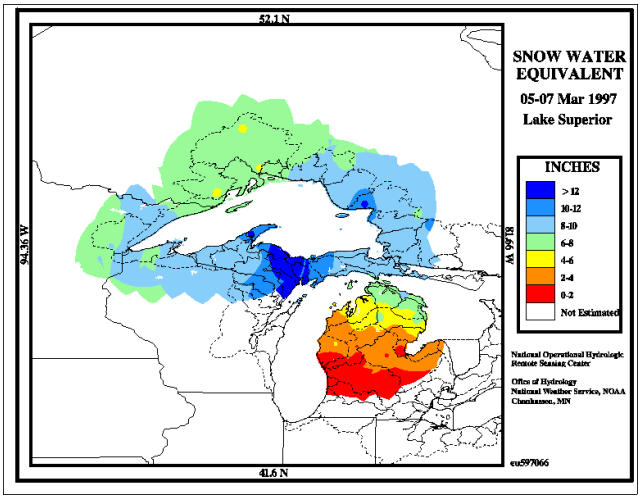
How has precipitation compared to average over the past 12 months?

According to published official precipitation records for the period March 1999 to February 2000, the Great Lakes as a whole have experienced 96% of average precipitation. However, much of the precipitation has been short-event, localized or lake-effect in nature, resulting in conditions drier regionally than indicated. The Corps of Engineers unofficial data shows only 77% of average precipitation fell during that same 12 month period on the entire Great Lakes basin and only 68% of average precipitation fell over the lakes Michigan-Huron basin.

How much effect does snow cover have on Great Lakes water levels?

Probably the most significant factor during the past three years of declining water levels has been the decrease in snow cover. As shown on the following graphics, the water content of the snowpack on the Lake Superior basin (snow-water equivalent or SWE) was almost non-existent for March 2000 compared to the same time period in 1997.





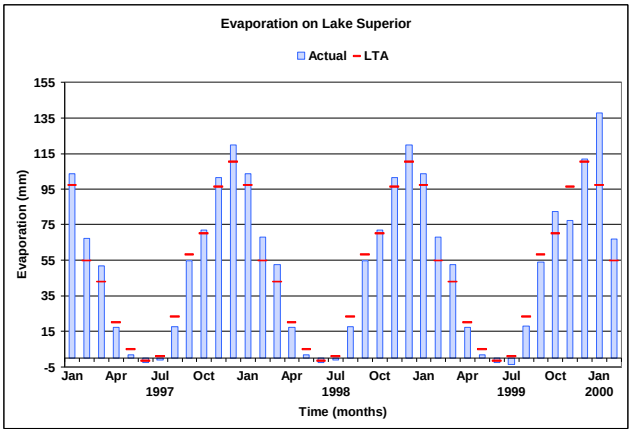
The winter 1996-97 snowpack was the primary source of the near record high levels in 1997. Snowmelt runoff is responsible for about 40% of the annual water supply into the Great Lakes and is the primary factor in normal springtime rise in water levels. With little or no snowmelt runoff, water supplies have been significantly impacted.

What role does evaporation play on the Great Lakes?

The evaporation process, for the most part, is an invisible but very significant factor in the loss of water from the Great Lakes. During prime evaporation periods, the Lakes may lose 1-2" of surface water per week due to this phenomenon.

Maximum evaporation occurs when the Great Lakes are much warmer than the air moving across them, particularly in the early fall until the lakes form ice. The evaporation results in many more cloudy days in Michigan than occur in Wisconsin, and is responsible for the "lake effect" snows that are common to the region.

Because warmer than average temperatures have persisted from 1998 through early 2000 across the region, lake ice coverage was minimal again this past winter. Without the ice cover, evaporation from the lakes was greatly increased during the winter months and has contributed directly to lower lake levels. The chart below shows Lake Superior's monthly evaporation data for January 1997 through February 2000.



These evaporation estimates are simulated using a model developed by the Great Lakes Environmental Research Laboratory (GLERL) and updated with data processed by the Midwest Climate Center, both of the National Oceanic and Atmospheric Administration.

Based on this model, the percent deviation in evaporation from a cumulative 3-year average was 106% on Lake Superior. The deviations for lakes Michigan, Huron, St. Clair, Erie and Ontario were 99%, 105%, 110%, 111%, and 98%, respectively.

How have recent conditions affected the groundwater supply?

Water that nourishes the Great Lakes also comes from other sources other than rain falling directly over basin. One of the greatest sources of water is the water table (or "groundwater") which is a primary source of the base flow for inland lakes and streams. On average, 42% of streamflow is from groundwater. Groundwater supplies are slow and steady, and can tolerate short to moderate droughts. However, lengthy periods of dry weather can stress groundwater supplies.

By April 2000, the United States Geologic Survey (USGS) was reporting very low to record low streamflow across the central and southern Great Lakes. Nearly forty percent of the streams in Michigan were flowing at record low levels at that time. Record low flows also are projected for northern rivers and streams in the coming months. This further indicates that inflows to the Great Lakes will be significantly below average through spring and summer of 2000.

The number of communities which acquire their potable water supply from groundwater is four times that supplied by surface water. Several rural areas near the Great Lakes are experiencing reduction in groundwater well discharges, which likely reflects a decline in the aquifer surface.

When was the last time levels were this low and how often have they been low?

Water levels have generally been recorded on the Great Lakes since about 1865. The April 2000 levels for Lake Superior have been lower five times since 1865, with the most recent severe low occurring in 1926.

Lakes Michigan-Huron have been lower than today three times since water levels have been recorded, the record low occurred in 1964. Lake St. Clair was lower than today in 1963, but was generally lower than today for an extended period that ran from 1923 to 1941. Lake Erie was lower than today in 1966, but water levels generally have been lower on this lake than the present time for most years between 1895 and 1942. Lake Ontario water levels are today only slightly lower than the long term average.

Water Level Controls

Where are the major outflow control points in the Great Lakes basin?

Limited water level control is achieved by regulating the outflows from Lakes Superior and Ontario, in accordance with the International Joint Commission (IJC) Orders of Approval for each lake. The outflows from the other Great Lakes depend exclusively on their levels.

Regulating the outflow from Lake Superior affects the level of lakes Superior, Michigan-Huron, and to a lesser extent St. Clair and Erie. Lakes Michigan and Huron are connected via the Straits of Mackinac and are considered one lake.

Regulating the outflow from Lake Ontario affects levels on the lake and on the St. Lawrence River from the Thousand Islands to downstream of Montreal, Quebec. It has no effect on levels on the upper lakes since Lake Ontario is separated from them by the Niagara Falls.

Could the flow out of Lake Superior be increased to raise water level on lakes Michigan-Huron, St. Clair, and Erie?

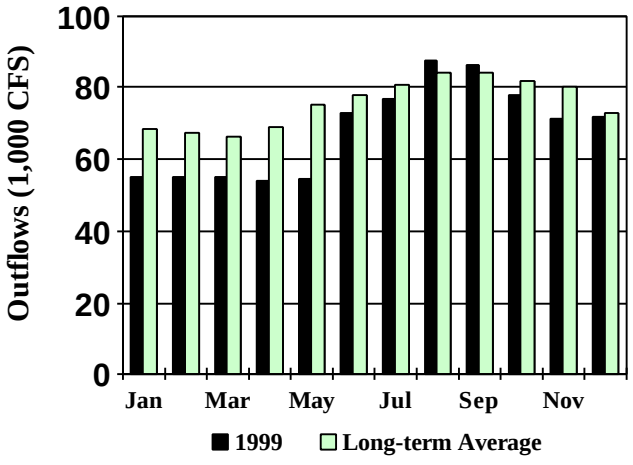
Yes, increasing the Lake Superior outflow may raise the water levels on lakes Michigan-Huron and to a lesser extent St. Clair and Erie. This influence on the levels of the lower lakes, however, is small and would require several months to raise the lower lakes an inch or more.

The International Lake Superior Board of Control (ILSBC) uses Regulation Plan 1977-A as the basis for determining Lake Superior outflows. The determination of Lake Superior outflows takes into consideration several factors, including the levels of lakes Superior and Michigan-Huron. The objective of this "systemic regulation" is to help maintain the levels of all three lakes relative to their long-term seasonal averages. Historic ranges of fluctuation and differing drainage basin sizes are considered.

Plan 1977-A works to attain this balance by making the amount of water stored on each of the lakes, as represented by their water levels, proportionally the same. If, for example, Lake Superior's water level was above its long-term average and lakes Michigan-Huron was below its average, the flows may be increased from Lake Superior to help balance the levels on the lakes.

Conversely, if Lake Superior levels are lower than seasonal average and lakes Michigan-Huron are above average, Lake Superior outflows may be similarly reduced. If both lakes Superior and Michigan-Huron levels are significantly below average, outflows from Lake Superior are generally below average. This has been the case over the last year as shown in the chart below.

Lake Superior Outflows



Could the flow out of Lake Superior be reduced to raise the water level on Lake Superior?

Yes, it is possible to reduce the Lake Superior outflow in order to either slow the fall, or raise the level of Lake Superior. The outflow, however, cannot be reduced to less than a "one-half gate open" setting at the Compensating Works in order to maintain enough water in the St. Marys Rapids for fish spawning.

Flow changes resulting from the monthly regulation of Lake Superior are accomplished by varying the amount of water allocated to hydropower production, and when necessary, by opening or closing gates in the Compensating Works at the head of the St. Marys Rapids.

Diversions

What are the diversions and how much can they affect Great Lake water levels?

The major diversions in the Great Lakes basin that affect water levels to a measurable extent are: (1) diversions into Lake Superior at Long Lac and Ogoki; (2) a diversion out of Lake Michigan at Chicago; (3) a diversion between lakes Erie and Ontario through the Welland Canal; and (4) the New York barge canal diversion. These diversions have a minor effect on water levels compared to natural factors and regulation of lakes Superior and Ontario.

The average annual flow rate into Lake Superior from the Long Lac and Ogoki diversions is 151 cms (5,300 cfs). These diversions are entirely in the Province of Ontario and were authorized between the U.S. and Canada in 1940. The flow through the Lake Michigan diversion at Chicago is 91 cms (3,200 cfs) and the flow from Lake Erie to Lake Ontario through the Welland Canal is 221 cms (7,800 cfs). This compares to the average outflow of 2,210 cms (78,000 cfs) from Lake Superior and 7,000 cms (247,000 cfs) from Lake Ontario.

Great Lakes Diversions

According to a 1985 report by the IJC, these diversions increase the supply of water to the Great Lakes, resulting in changes to water levels. The long-term effect has been to increase the mean water levels on each of the lakes. The mean level of Lake Superior has changed by 6.4 cm (2.5 in), Lakes Michigan-Huron have changed by 11.3 cm (4.5 in), Lake Erie has changed by 7.6 cm (2.9 in), and Lake Ontario has changed by 6.7 cm (2.6 in).

How are the Long Lac and Ogoki diversions affecting the Great Lakes now?

The Long Lac and Ogoki diversions have far-reaching economic benefits to the region; they provide water for hydropower production in northern Ontario, and provide further waters for hydropower production through the St. Marys River, Niagara River / Welland Canal and the St. Lawrence River.

The combined Long Lac and Ogoki flow for 1998 and 1999 are shown in the table on the following page. Dry conditions during 1998 resulted in 48% of average flows through the Long Lac and Ogoki diversions. The flow in 1999 was 124% of average.

Combined Long Lac & Ogoki Diversion

	Mean 1944-1998*	*Mean* 1998*	*Mean* 1999*
JAN	130 (4591)	80 (2825)	140 (4944)
FEB	111 (3920)	80 (2825)	100 (3531)
MAR	94 (3320)	50 (1766)	90 (3178)
APR	89 (3143)	40 (1412)	70 (2472)
MAY	185 (6533)	60 (2119)	180 (6357)
JUN	260 (9182)	30 (1059)	250 (8829)
JUL	202 (7134)	40 (1412)	200 (7063)
AUG	164 (5792)	40 (1412)	190 (6992)
SEP	144 (5085)	40 (1412)	210 (7416)
OCT	141 (4979)	80 (2825)	290 (10241)
NOV	150 (5297)	160 (5650)	340 (12007)
DEC	147 (5191)	160 (5650)	180 (6357)
Annual	151 (5332)	72 (2543)	154 (5438)

* units - cms (cfs)

Although the diversions are under private control, there has been consultation and cooperation between the Governments of the Unites States and Canada to request changes in the outflows from these diversions during emergency periods.

Could the outflow be decreased from the Lake Michigan Diversion at Chicago to keep more water on Lakes Michigan-Huron?

Generally, no. Any decrease would require significant changes in institutional arrangements and would generate significant economic losses.

Water from Lake Michigan and its drainage basin is diverted into the Des Plaines River, a tributary of the Illinois River and a part of the Mississippi River drainage basin. The Lake Michigan Diversion has an average flow rate of 91 cms (3,200 cfs), which is managed in accordance to U.S. Supreme Court decrees.

Since 1938, the diversion has resulted in a permanent lowering of Lakes Michigan-Huron of about 6 cm (2.5 in) and Lake Erie about 4 cm (1.5 in).

These waters are used primarily for domestic and industrial purposes, including municipal wastewater treatment for the metropolitan area around Chicago. The diversion also supplies water to maintain channel depths needed for water-borne transportation of goods from the Mississippi River to Chicago.

Dredging

What type of work requires a Corps permit?

Any construction work on navigable waters, including all types of dredging, requires a permit from the Corps of Engineers. Section 10 of the Rivers and Harbors Act of 1899 specifically gives the Corps the responsibility of regulating work in all navigable waters of the United States.

If I apply for a permit to dredge, how many agencies must approve it?

You must obtain a federal permit from the U.S. Army Corps of Engineers, most states, and some local governments, (i.e. county drainage board, township, city, etc.).

How long does it take to get permits approved through the Corps?

Again, this varies by Corps district and state. Depending on the magnitude of the project, issuance of a permit may take anywhere from one month to three months; it could take longer, or be denied, if the project is controversial or involves unacceptable impacts. If the project qualifies for a general permit from the Corps, issuance could occur anywhere from three to six weeks. An individual letter of permission usually can be issued in 30 to 60 days, whereas a standard permit, involving issuance of a public notice, usually takes 90 days, or longer. Permit packages which lack crucial information may significantly delay the Corps decision on a dredging application.

Does the Corps have to do a site visit during the processing of a permit application?

Site inspections are performed for dredging applications when there are environmental or physical concerns over the effects of the dredging and/or the placement of dredge material. For projects, which may involve some controversy, Corps personnel would determine if objections are substantive and/or valid.

Is sediment testing of dredged materials always required ?

This requirement differs depending upon the respective Corps district and state which has jurisdiction over the proposed project. For some Districts, if there is no reason to suspect contamination, i.e., dredging will not occur in a location designated as an Area of Concern by IJC, or near a known source of contamination and upland disposal is proposed, it is not likely testing would be required. Information regarding IJC Areas of Concern may be found on the IJC webpage below.

Does the Corps impose calendar dredge closure dates (dredge windows) on all or some waters under their jurisdiction?

The Corps would not place a restriction on dredging permits unless the dredging would occur in a known important resource area or unless the state agency has requested the Corps to place the restrictions on Federal permits, or has issued a permit, prior to issuance of the Federal permit, with dredge windows.

Points of Contact

U.S. Army Corps of Engineers
Great Lakes Regional Center
111 North Canal Street
Chicago, IL 60606
Phone: 312-353-6310
Fax: 312-353-5233
http://www.lrd.usace.army.mil/gl/gl.htm

U.S. Army Corps of Engineers
Buffalo District
1776 Niagara Street
Buffalo, NY 14207
Phone: 716-879-4104
http://www.lrb.usace.army.mil/

U.S. Army Corps of Engineers
Chicago District
111 North Canal Street
Chicago, IL 60606-7206
Phone: 312-353-6400
http://www.usace.army.mil/lrc

U.S. Army Corps of Engineers
Detroit District
477 Michigan Avenue
Detroit, MI 48226
Phone: 313-226-6440
Fax: 313-226-2398
http://www.lre.usace.army.mil

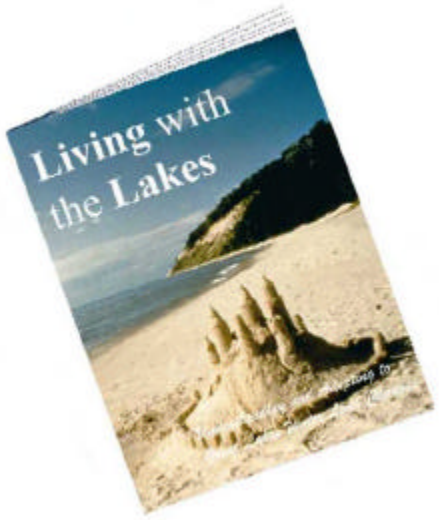
Environment Canada
Great Lakes Water Level Communication Centre
867 Lakeshore Road
Burlington, ON L7R 4A6
Phone: 905-336-4580
Fax: 905-336-8901

Environment Canada
Great Lakes – St. Lawrence Regulation Office
111 Water Street East
Cornwall, ON K6H 6S2
Phone: 613-938-5725
Fax: 613-937-1302

Department of Fisheries and Oceans
Canadian Hydrographic Service
867 Lakeshore Road
Burlington, ON L7R 4A6
Phone: 877-247-5465
Fax: 905-336-8916
http://chswww.bur.dfo.ca/danp/

International Joint Commission
http://www.ijc.org

Want to learn more about the ups and downs of the Great Lakes water levels?



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